FINAL DRAFT

EVALUATION METHODOLOGY FOR THE WATER QUALITY IMPROVEMENT STRATEGIES FOR THE EVERGLADES

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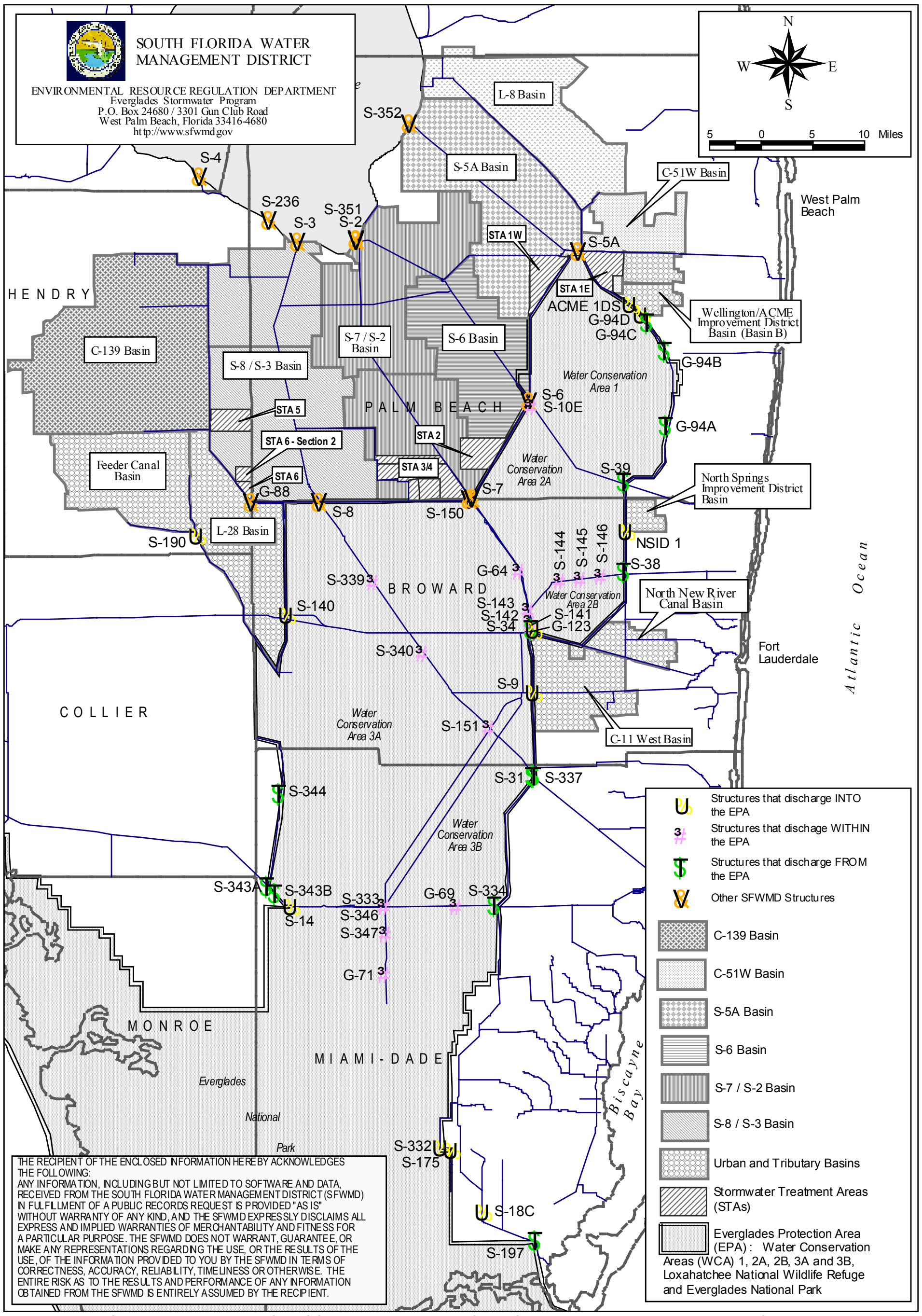
EXECUTIVE SUMMARY

Florida's 1994 Everglades Forever Act (Act) establishes both interim and long-term water quality goals to achieve restoration and protection of the Everglades Protection Area (EPA). The South Florida Water Management District (District), in partnership with other agencies and private landowners, is aggressively and successfully achieving these interim milestones. Basin-specific feasibility studies will evaluate alternative combinations of source controls and public works to achieve compliance with the long-term water quality standards for the Everglades Protection Area. Based on guidance provided by the 1994 Everglades Forever Act, the 2000 Water Resource Development Act, and relevant Florida Statutes, a methodology is proposed to evaluate these alternatives. The proposed methodology also includes recommended evaluation criteria, addressing technical performance, environmental factors, and economic considerations.

This evaluation of alternative water quality improvement strategies is a fact-gathering activity, and by itself cannot determine or recommend an "optimal" combination of water quality treatment solutions. However, the results of the evaluation will give the Legislature, the District Governing Board, and other stakeholders the critical technical information necessary for the policy decisions needed to determine the "optimal" combination of water quality treatment solutions. To aid this process, a multi-criteria decision-making process will be used subsequent to the technical evaluation. During this process, weighting factors for the criteria will be developed in concert with stakeholders, and sensitivity analyses will be performed to demonstrate how the "optimal solution" would differ based on changes in the relative weights.

1.0 INTRODUCTION

Florida's 1994 Everglades Forever Act (Act) establishes both interim and long-term water quality goals to achieve restoration and protection of the Everglades Protection Area (EPA; see Figure 1). The District, in partnership with other agencies and private landowners, is aggressively and successfully achieving these interim milestones. The District has constructed four Stormwater Treatment Areas (STAs) totaling almost 20,000 acres, and has just begun construction of the largest one, STA-3/4, with more than 17,000 acres. In addition, the Corps of Engineers is constructing the 5,500-acre STA-1 East. The STAs, coupled with on-farm Best Management Practices (BMPs) are designed to reduce the total phosphorus (TP) concentration in runoff from approximately 150 ppb to an interim target of 50 ppb. EAA landowners have implemented BMPs that have reduced phosphorus loads by more than 50% over the last six years. Concurrent with implementation of the Everglades Construction Project (ECP), the District is



ERRD/ESP REV. 04-JUN-2001 CMIESSAU x:\ever-gis\ecp\aprfiles\ECP-Basins-cm1.apr Basin Feasibility Studies (13 Basins)-L

Figure 1. Overview of the Everglades Protection Area.

implementing the Everglades Stormwater Program (ESP) to address the water quality issues associated with discharges from the remaining non-ECP Everglades tributary basins. Also concurrent with these activities, the District and other groups are conducting water quality research and ecosystem-wide planning, and implementing regulatory programs to ensure a sound scientific foundation for decision-making.

The long-term Everglades water quality objective is to implement the optimal combination of source controls, STAs, Advanced Treatment Technologies (ATTs), and/or regulatory programs to ensure that all waters discharged to the Everglades Protection Area (EPA) achieve water quality goals by December 31, 2006. Permit applications and integrated water quality plans are to be submitted to the Florida Department of Environmental Protection (FDEP) by December 31, 2003. To meet these objectives and time frames, the District is conducting basin-specific feasibility studies that will integrate information from research, regulation, and planning studies to provide information necessary to allow policy makers to determine the optimal combination of source controls and basin-scale treatment to meet the final water quality objectives.

The Everglades Forever Act mandated that additional treatment strategies be considered to reduce phosphorus levels to achieve the as-yet-undetermined numeric phosphorus standard. Advanced treatment technology research efforts are currently underway to determine the phosphorus removal capabilities of nine technologies:

1. Chemical Treatment - Direct Filtration
2. Chemical Treatment - High Rate Sedimentation
3. Chemical Treatment - Dissolved Air Floatation
4. Chemical Treatment – Microfiltration
5. Low Intensity Chemical Dosing of Wetlands
6. Managed Wetlands
7. Submerged Aquatic Vegetation (SAV) - Limestone Treatment
8. Periphyton Stormwater Treatment Areas (PSTAs)
9. Wetlands (STAs)

Currently, the remaining viable candidates include Chemical Treatment - High Rate Sedimentation, Submerged Aquatic Vegetation (SAV), Periphyton Stormwater Treatment Areas (PSTAs), and STAs. In general, then, research efforts have culminated in a reduction down to two alternative treatment technologies: biological (a treatment train potentially consisting of some combination of emergent, SAV and periphyton) and chemical treatment. Research is continuing to better refine the engineering, economic and phosphorus reduction characteristics of these candidates. Results from the research, which are presented in demonstration project final reports using a standardized format, are intended to be incorporated into this Evaluation Methodology.

2.0 OVERVIEW OF THE BASIN-SPECIFIC FEASIBILITY STUDIES

2.1 Scope

The goal of the basin-specific feasibility studies is to integrate research, planning and other available information into viable **water quality improvement strategies** to ensure that all waters discharged into the EPA achieve water quality goals. Of the sixteen basins that discharge into the EPA, the basin-specific feasibility studies will identify and evaluate alternative combinations of source control and basin-scale treatment for thirteen hydrologic basins – eight basins covered by the Everglades Construction Project (ECP) and six basins covered by the Everglades Stormwater Program (ESP). The remaining two ESP basins (C-111 Basin and Boynton Farms Basin) will be addressed through other District and Federal programs. A summary of the basins covered in the basin-specific feasibility studies is presented in Table 1.

2.2 Baseline Data

Baseline flows and phosphorus data sets have been developed by the District for thirteen basins to be evaluated by the basin-specific feasibility studies (Goforth and Piccone, 2001). A 31-year data set consisting of daily flow and phosphorus concentrations was developed for each basin and is summarized in Table 2. The baseline data set combined simulated flow values from the South Florida Water Management Model (SFWMM) for the period 1965-95 with historic phosphorus concentrations developed from water years 1990-1999.

Table 1. Everglades Protection Area Tributary Basins Included in the Basin-Specific Feasibility Studies

Basin	Canal	STA	Receiving Water
S-5A	West Palm Beach Canal	STA-1E, STA-1W, STA-2	WCA 1
S-6	Hillsboro Canal	STA-2	WCA 2A
S-7	North New River Canal	STA-3/4	WCA 2A, WCA 3A
S-8	Miami Canal	STA-3/4, STA-6	WCA 2A, WCA 3A
C-139	L-1, L-2, L-3	STA-3/4, STA-5, STA-6	WCA 2A, WCA 3A
C-139 Annex	L-28	STA-6	WCA 3A
C-51 West	C-51 West Canal	STA-1E, STA-1W	WCA 1
North Springs Improv. District	N/A	N/A	WCA 2A
North New River Canal	North New River Canal	N/A	WCA 3A
C-11 West	C-11 West	N/A	WCA 3A
Feeder Canal	L-28 Interceptor Canal	N/A	WCA 3A
L-28	L-28 Canal	N/A	WCA 3A
ACME Basin B	L-40	N/A	WCA 1

Table 2. Summary of Simulated Baseline Flows and Phosphorus (1965-1995)

Basin / STA	Mean Annual STA Inflow (acre-feet)	STA Inflow Phosphorus (parts per billion)	Mean Annual Phosphorus Load (kg)	Mean Annual Discharge to EPA (acre-feet)	Discharge Phosphorus (parts per billion)	Mean Annual Phosphorus Load (kg)
C-51 West / STA-1 East	133,331	176	28,950	136,406	50	8,406
S-5A / STA-1 West	160,335	139	27,399	161,902	34	6,815
S-6 / STA-2	233,473	100	28,831	229,273	48	13,492
S-7, S-8 / STA-3/4	660,889	88	72,019	637,901	49	38,650
C-139 / STA-5	85,637	167	17,634	83,776	38	3,938
EAA, C-139 Annex / STA-6 (Sections 1 and 2)	80,532	121	12,050	74,930	34	3,104
Acme Basin B	N/A	N/A	N/A	31,499	94	3,660
North Springs Improvement District	N/A	N/A	N/A	6,168	39	293
N. New River Canal Basin	N/A	N/A	N/A	1,781	18	40
C-11 West Basin	N/A	N/A	N/A	194,167	17	4,063
L-28 Basin	N/A	N/A	N/A	83,806	39	3,982
Feeder Canal Basin	N/A	N/A	N/A	77,179	156	14,854

Reference: Goforth and Piccone, 2001

2.3 CERP Projects

The majority of Everglades tributary basins covered in the feasibility studies contain components of the Comprehensive Everglades Restoration Plan (CERP). These projects, summarized in Table 3, will significantly influence baseline flows and water quality characteristics. An opportunity exists for cost savings by integrating the long-term water quality solutions with the CERP components. Analyses of the impacts of integrating with CERP projects will be included during the development and evaluation of alternatives for each of the basins.

2.4 Remaining Work

The three remaining steps in the basin-specific feasibility studies include:

1. Develop the Evaluation Methodology based on the criteria established in the 1994 Everglades Forever Act, and other appropriate considerations.
2. Develop basin-specific alternative combinations of water quality solutions (e.g., source control, STA optimization, and Advanced Treatment Technologies).
3. Evaluate the alternatives.

It is anticipated that once the alternatives are evaluated and sufficient funds are appropriated, individual **water quality improvement strategies** will be finalized for each basin, and subsequent design and construction will proceed.

Table 3. CERP Projects Within Everglades Tributary Basins to be Addressed in the Water Quality Feasibility Studies

CERP Project	Compl. Date	STA -1E	STA -1W	STA -2	STA -3/4	STA -5	STA -6	ACME "B"	NNRC	NSID	C-11W	L-28	Feeder Canal
S-9A Seepage Pump & S-381 Divide Structure (A5.5.5)	*3/31/02 11/15/02*										✓		
ACME Basin "B" (A6.3.3.6)	4/25/07							✓					
Rotenberger WMA Operations (EE5)*	5/3/06				✓	✓	✓						
Site 1 Impoundment (M6)	**10/24/07**									✓			
C-11 Impound. & STA (Q5)	**1/25/06**										✓		
Miccosukee WMA (A5.5.26 & A6.3.4.6)	*2008* ?											✓	
Seminole Water Conserv. Plan (A5.5.6 & A6.3.4.1)	*2008* ?												✓
Holey Land WMA Operations (DD)*	3/26/08				✓	✓							
Pump Station G-404 Modification (II3)	9/24/08				✓		✓						
North New River Canal Improvements (SS4)	**10/22/08**								✓				
EAA Storage Reservoirs Ph. 1 (G6)	**9/16/09**			✓	✓	✓	✓						
WCA 3A/3B Levee Seepage Management	**10/22/08**										✓		

CERP Project	Compl. Date	STA -1E	STA -1W	STA -2	STA -3/4	STA -5	STA -6	ACME “B”	NNRC	NSID	C-11W	L-28	Feeder Canal
(O)													
Decompartmentalization of WCA 3 (QQ6)*	10/4/10			✓	✓		✓						
L-8 Basin (K Ph 1)	3/18/11	✓	✓										
C-51 & Southern L-8 Reservoir (GGG6)	3/14/14	✓	✓										
Site 1 ASR (M6)	3/17/17									✓			
Miccosukee STA (CCC6)	6/16/15											✓	
Seminole STA (CCC6)	6/16/15											✓	✓
WCA 2 and WCA 3 Diversion Structures (YY4)													
L-8 Basin ASR (K Ph 2)	10/18/18	✓	✓										
EAA Storage Reservoirs Ph. 2	9/17/14			✓	✓	✓	✓						
C-51 Regional ASR (LL)	10/15/20	✓	✓										
Everglades Rain driven Operations (H6)*	?			✓	✓		✓						

Notes:
1. CERP Projects in Bold were included in the initial project authorization in WRDA 2000.
2. Critical Restoration Projects are shown in Italics and are followed by an ID number beginning with “A5”.
3. Other Project Element components have an ID number beginning with “A6”.
4. Completion dates taken from 7/27/2001 Update to CERP Master Implementation Schedule.
5. Projects listed with an asterisk (*) are not expected to influence the flows and phosphorus loads discharged from the Everglades Tributary basins.

3.0 EVALUATION METHODOLOGY

The proposed methodology to evaluate alternative water quality measures in each basin has been refined with stakeholder input and has been independently peer-reviewed. The latest version of the methodology includes revisions made to the August 31, 2001 version, and the November 14, 2001 version. For a brief description of the revisions, refer to the Appendices. The proposed Evaluation Methodology consists of the following two components:

1. Establish the evaluation criteria
2. Establish the method by which the alternatives will be evaluated

3.1 Basis for the Evaluation Criteria

The overall goals of Everglades restoration are to improve water quality; improve the quantity, distribution, and timing of water; and to control the spread of exotic species. **The following section describes the goals and objectives specific to improving water quality.** The Comprehensive Everglades Restoration Plan is the primary mechanism for improving the quantity, distribution and timing of water, while a coordinated State and Federal program is addressing the control of exotic species.

3.1.1 Everglades Water Quality Improvement Goal

The 1994 Everglades Forever Act, the 2000 Water Resources Development Act (WRDA), and the 1992 Federal Everglades Consent Decree (amended 2001) describe the general water quality goal of Everglades restoration as implementation of comprehensive and innovative solutions to restore and protect the Everglades ecosystem while maintaining the quality of life for all residents of South Florida, including those in agriculture. These solutions shall **improve water quality**, such that all waters delivered to the Everglades Protection Area achieve and maintain compliance with state water quality standards.

3.1.2 Everglades Water Quality Improvement Objectives

Specific objectives were enumerated by the 1994 Everglades Forever Act to achieve the Everglades Water Quality Improvement Goal.

1. The Florida Department of Environmental Protection (FDEP) shall evaluate existing water quality standards applicable to the EPA and the EAA canals.
2. By December 31, 2003, the FDEP shall adopt the numeric phosphorus criterion or the default shall be 10 ppb. In addition, the FDEP shall establish the method for determining compliance with the phosphorus standard, including monitoring locations and frequency of sampling.

3. The FDEP shall establish discharge limits necessary to prevent an imbalance in the natural populations of aquatic flora or fauna in the EPA, and to provide a net improvement in the areas already impacted.
4. **By 12/31/03, the District shall submit permit modifications containing plans for achieving and maintaining compliance with State water quality standards, including phosphorus. The permit application shall include proposed cost estimates, proposed funding mechanisms, and proposed implementation schedules. *Collectively, these are called the Water Quality Improvement Strategies.***
5. **By 12/31/06, the Department and District shall take such actions as may be necessary so that water delivered to the EPA achieves State water quality standards, including the phosphorus criterion, in all parts of the EPA.**

This Evaluation Methodology has been developed to assist in achieving objectives 4 and 5.

3.1.3 The 1994 Everglades Forever Act

The 1994 Everglades Forever Act (ss. 373.4592, Florida Statutes) provides fundamental guidance on the criteria to be considered in evaluating alternative technologies:

> *2. The Legislature recognizes that technological advances may occur during the construction of the Everglades Construction Project. If superior technology becomes available in the future which can be implemented to more effectively meet the intent and purposes of this section, the District is authorized to pursue that alternative through permit modification to the department. The department may issue or modify a permit provided that the alternative is demonstrated to be superior at achieving the restoration goals of the Everglades Construction Project considering:*
>
> *a. Levels of load reduction;*
> *b. Levels of discharge concentration reduction;*
> *c. Water quantity, distribution, and timing for the Everglades Protection Area;*
> *d. Compliance with water quality standards;*
> *e. Compatibility of treated water with the balance in natural populations of aquatic flora or fauna in the Everglades Protection Area;*
> *f. Cost-effectiveness; and*
> *g. The schedule for implementation.*

In addition, the Everglades Forever Act contains the following guidance:

> *Implement solutions while minimizing impacts on South Florida jobs, including agricultural, tourism, and natural resource related, all of which contribute to a robust regional economy*

Note: Although specific socio-economic criteria are not included is this Evaluation Methodology, socio-economic issues will be addressed in the NEPA process during the permitting phase for the recommended alternatives.

3.1.4 Integration with CERP

Federal and State statutes mandate that the implementation of CERP be integrated with other water resource projects (ss. 373.206, 373.1501, F.S., WRDA 2000), including the long-term water quality measures mandated by the Everglades Forever Act. Hence, the scope and timing of CERP projects need to be considered when evaluating long-term water quality solutions. Although specific CERP integration criteria are not included in this Evaluation Methodology, CERP integration is being addressed in the development and evaluation of the alternative combinations for each of the basins.

3.1.5 The Federal Clean Water Act

The Federal Clean Water Act contains guidelines for evaluating alternative projects that discharge fill or dredge materials into waters of the United States. As appropriate, these criteria will be considered on a qualitative basis by the District in consultation with FDEP, the U.S. Corps of Engineers, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service and other agencies as appropriate. Although specific criteria for these guidelines are not included in this Evaluation Methodology, compliance with the Clean Water Act guidelines will be addressed in the NEPA process during the permitting phase for the recommended alternatives.

3.1.6 Other Considerations

As part of the Supplemental Technology Standard of Comparison (STSOC)**,** evaluation criteria were developed based on the above considerations of the EFA and other relevant criteria, including scale-up uncertainty, operational flexibility, management of side streams, and sensitivity to extreme conditions (PEER Consultants, P.C./Brown and Caldwell, 1998). The results of applying these evaluation criteria to the 1979-88 STA-2 flows and loads will be carried over for use in this evaluation (modified as appropriate to the alternative being evaluated).

The compatibility of treated water with the balance in natural populations of aquatic flora or fauna in the Everglades Protection Area, including the potential toxicity criterion of the STSOC, is a factor to be considered during the permitting process pursuant to the Everglades Forever Act requirements. FDEP, the District and other stakeholders are currently working to reach consensus on "compatibility". If that definition is available during the feasibility studies, and if sufficient existing data are available to assess compatibility, then it will be used in the feasibility studies and an additional compatibility criterion will be added to the Evaluation Methodology. If, not, then the issue of compatibility will be addressed during the subsequent design and permitting process.

3.2 Evaluation Criteria

Over the last decade there have been at least three separate evaluations of alternative treatment systems for the Everglades, each conducted for different objectives (Brown and Caldwell, 1993, PEER Consultants, P.C./Brown and Caldwell, 1996; PEER Consultants, P.C./Brown and Caldwell, 1998). In general, the evaluation criteria have covered technical, environmental, and economic factors, and have ranged in number from 10 to 24. Based on the above statutory guidance and other considerations, evaluation criteria are proposed for use in the present evaluation covering the categories of **Technical Performance, Environmental Factors, and Economic Considerations**. The following sections describe these evaluation criteria and provide examples for their use. To aid this process, a multi-criteria decision making process will be used subsequent to the technical evaluation. During this process, weighting factors for the criteria will be developed in concert with stakeholders, and sensitivity analyses will be performed to demonstrate how the "optimal solution" would differ based on changes in the relative weights. More information on this process is provided in Section 5.

3.2.1 Technical Performance Evaluation Criteria

Technical Performance Evaluation Criteria Nos. 1-2: Level of phosphorus reduction.

The purpose of these evaluation criteria is to determine the level of phosphorus reduction for the alternative. Two aspects of phosphorus reduction will be evaluated: load and concentration. The data to be used for this evaluation will be results from simulations to be conducted during the feasibility studies, using the Dynamic Model for Stormwater Treatment Areas (DMSTA) (Walker and Kadlec, 2001). DMSTA simulates the flows and phosphorus removal within water quality treatment facilities (see Section 4.1). The calculation will compare the average annual phosphorus load and concentration derived for the 1965-95 baseline period with the average annual load and concentration (both the long-term flow-weighted mean and long-term geometric mean of weekly flow-weighted means) for the alternative being evaluated. This load calculation and comparison will use the period December 31, 2006 through December 31, 2056.

Example:

1965-1995 baseline period average annual phosphorus levels for Basin X: 12.5 metric tons/yr and 65 ppb
Alternative 1 average annual phosphorus load: 2.9 metric tons/yr and 15 ppb
Level of Phosphorus Load Reduction = 12.5 – 2.9 = **9.6 metric tons/yr (76.9%)**

Hence, the result for this criterion is 76.9%

Long-term Flow-weighted Mean Outflow Phosphorus Concentration Achieved = 15 ppb

Hence, the result for this criterion is 15 ppb

Long-Term Geometric Mean Outflow Phosphorus Concentration Achieved = 12 ppb

Hence, the result for this criterion is 12 ppb

Technical Performance Evaluation Criterion No. 3: Implementation schedule.

The purpose of this evaluation criterion is to compare alternatives based on the length of time required to design, construct, acquire land, and achieve full treatment capability, including any treatment start-up and stabilization. For alternatives with basin-scale public works as a component, schedule information obtained from the research teams regarding the time required for full-scale implementation of the technology will be used as an evaluation factor for this criterion. For alternatives with no basin-scale public works as a component, best professional judgement will be used. The value used for comparing the alternatives will be the duration in years required to produce a stable treatment system, assuming start of design on January 1, 2003, and the final completion date.

Example:

Basin X, Alternative 1 proposes chemical treatment. According to the narrative in the final report for this technology (HSA, page 157), the duration from finalizing process design criteria through permitting, land acquisition, construction, full-scale start-up and troubleshooting of constructed facility is reported to be

3.5 Years
Final completion date: June 1, 2006

If funding and land acquisition, which can both have a great deal of uncertainty, can be completed prior to June 2003, this alternative could be implemented prior to the December 2006 deadline.

Hence, the result for this criterion is 3.5 years

Technical Performance Evaluation Criterion No. 4: Operational Flexibility.

The purpose of this evaluation criterion is to assess the potential for the alternative to add operational flexibility to the South Florida hydraulic conveyance system and the Everglades Water Conservation Areas, while still meeting treatment objectives. This concept was developed for the STSOC, and was described in *Evaluation Methodology for Comparison of Supplemental Technology Demonstration Projects* (PEER Consultants, P.C./Brown and Caldwell, 1998):

> Factors such as peak flow attenuation, available storage capacity, effect on green space and wildlife habitat will be qualitatively assessed for each technology under this concept. The demonstration project research team shall present a short summary discussion documenting the ability of the supplemental technology to affect the factors listed above.

For alternatives with a public works component, the data used in this evaluation will come from the research demonstration project for each individual treatment technology (e.g., STA, SAV, PSTA, or chemical treatment), or, best professional judgement of the

Consultants if the STSOC is incomplete or if combinations of technologies are used. Scores for this evaluation criterion will be assigned based on the following guidelines:

-3 to -1 if the alternative reduces operational flexibility of the regional system.
0 if the alternative has little or no impact on operational flexibility.
+1 to +3 if the alternative increases flexibility in operation of the regional system.

Example:

Basin X, Alternative 1 proposes chemical treatment. Narrative on operational flexibility is provided in the final report for chemical treatment (HSA, p. 157-158). Operational flexibility is provided by the flow equalization basin component of this alternative, which allows attenuation of peak flows and storage of water during extreme rainfall events.

Hence, the result for this criterion is +3.

<u>Technical Performance Evaluation Criterion No. 5: Resiliency to fire, flood, drought and hurricane.</u>

The purpose of this evaluation criterion is to assess the resiliency of a treatment system to fire, flood, drought and hurricane by determining the ability of the technology to re-establish design effluent conditions following such events. This concept was developed for the STSOC, and was described in *Evaluation Methodology for Comparison of Supplemental Technology Demonstration Projects* (PEER Consultants, P.C./Brown and Caldwell, 1998). Information to be provided by the demonstration project reports includes:

- Description of effect of fire, flood, drought and hurricane on the treatment facilities
- Time to re-establish design effluent conditions following such events
- Cost to re-establish design effluent conditions following such events

For alternatives with a public works component, the data used in this evaluation will come from the demonstration project reports for each individual treatment technology (e.g., STA, SAV, PSTA, or chemical treatment), or, if the STSOC is incomplete, best professional judgement. Scores for this evaluation criterion will range from +4 to –4 and will be assigned based on the following guidelines:

+1 for each event to which the alternative should generally be resilient
0 for each event that should generally have no influence on the alternative
-1 for each event to which the alternative should generally have a lack of resiliency

Example:

Basin X, Alternative 1 proposes chemical treatment. Narrative on resiliency to fire, flood, drought and hurricane is provided in the final report for chemical treatment (HSA, page 158). While on-site fire, flooding and extreme weather (tornado) could have short-term impacts to the operation of the treatment plant itself, this alternative should generally be resilient to the four extreme events.

Hence, the result for this criterion would be +4.

<u>Technical Performance Evaluation Criterion No. 6: Assessment of full-scale construction and operation.</u>

The purpose of this evaluation criterion is to assess the potential for the alternative to succeed in full-scale construction and operation. This concept was developed for the STSOC as described in *Evaluation Methodology for Comparison of Supplemental Technology Demonstration Projects* (PEER Consultants, P.C./Brown and Caldwell, 1998), and is adopted for use in this Evaluation Methodology. The history and confidence level for the scale-up of a technology will be qualitatively assessed. Some of the parameters used to evaluate this concept are history of previous applications, differences between the Everglades Construction Project (ECP) and the previous applications, history of success or failure, assumptions made during the scale-up design, constructability and factors considered to require additional study. In addition, an assessment will be made of the uncertainty for construction and operations parameters (e.g., harvesting, sludge disposal/reuse) that may have a significant effect on cost.

For alternatives with a public works component, the data used in this evaluation will be based on the results of the research demonstration project presented pursuant to the STSOC standards for the individual treatment technology, modified as appropriate to the scale of the alternative. For alternatives with no public works component or if the STSOC is incomplete, best professional judgement will be used. Scores for this evaluation criterion will be assigned based on the following guidelines:

+1 to +3 if the alternative has been successfully constructed and operated at the proposed scale and no scale-up problems are anticipated;
0 if the alternative has not been successfully constructed and operated at the proposed scale, but no scale-up problems are anticipated;
-3 to -1 if the alternative has not been successfully constructed and operated at the proposed scale, or if scale-up problems are anticipated.

Example:

Basin X, Alternative 1 proposes chemical treatment. According to the final report on chemical treatment, this technology has been successfully constructed and operated at large scale (two facilities are more than 500 MGD). However, scale-up concerns include chemical dosing efficiency, among others, so ***the result for this criterion is –3.***

Technical Performance Evaluation Criterion No. 7: Management of side streams.

The purpose of this evaluation criterion is to assess the level of effort required to manage side streams of each alternative. This concept was developed for the STSOC, and was described in *Evaluation Methodology for Comparison of Supplemental Technology Demonstration Projects* (PEER Consultants, P.C./Brown and Caldwell, 1998):

> The level of effort required to manage side streams is dependent upon various factors such as volume of side streams, type of side stream (sludge, residual solids, harvested vegetation) and method of disposal. This concept is considered an ancillary issue and will be evaluated qualitatively. The demonstration project research team shall list the annual volume of the side streams generated (including seepage losses) and their characteristics. The team shall also list likely, worst case, and best case disposal and reuse options for the side streams.

For alternatives with a public works component, the data used in this evaluation will come from the demonstration project for each individual treatment technology (e.g., STA, SAV, PSTA, or chemical treatment), or, if the STSOC is incomplete, best professional judgement. Scores for this evaluation criterion will be assigned based on the following guidelines:

+1 to +3 if there should be a net benefit from management of the side streams
0 if the alternative requires no management of side streams
-3 to -1 if the alternative requires extensive effort and/or cost for management of the side streams, or there is potentially a net adverse impact associated with management of the side streams.

Example:

Basin X, Alternative 1 proposes chemical treatment. In the narrative provided in the final report for chemical treatment (HSA, pages 158-159), land application is identified as the most cost-effective method for management of residuals. Because of the volume of residuals generated by this alternative, management of the residuals would require extensive effort and cost; ***hence, the result for this criterion is -3.***

3.2.2 Environmental Evaluation Criteria

Environmental Evaluation Criterion No. 1: Level of improvement in non-phosphorus parameters.

The purpose of this evaluation criterion is to determine the level of improvement in non-phosphorus parameters for the alternative. A total of 19 non-phosphorus parameters are to be included in testing to be conducted for the STSOCs. For alternatives with a basin-scale public works component, the data used in this evaluation will come from the demonstration project for each individual treatment technology (e.g., STA, SAV, PSTA, or chemical treatment). For alternatives with no basin-scale public works component, it will be assumed that there will be no significant change in the non-phosphorus water quality.

Scores for this evaluation criterion will range from –19 to +19 and will be assigned based on the following guidelines (using the STSOC data):

+1 for each parameter improved
0 for a parameter with no significant change
-1 for each parameter worsened

Example:

For a given alternative, 8 of the non-phosphorus parameters are improved, and no substantive change is projected for the remaining eleven. The score for this alternative would then be 8+0=8. For another alternative, no substantive change is projected for eleven parameters, but the levels of 8 parameters are expected to worsen. ***Hence, the result for this alternative would then be 0+(-8)=-8.***

3.2.3 Economic Evaluation Criteria

Economic Evaluation Criteria Nos. 1-2: Costs.

The purpose of this evaluation criterion is to determine the **costs and related cost-effectiveness** of each alternative. Two aspects will be evaluated for each alternative: 50-yr present worth public costs, and unit costs for phosphorus removal. The total cost estimate for each alternative shall include capital (design and engineering, equipment, land acquisition, construction and civil work), associated program management costs, and operation and maintenance costs, and will be reported as a 50-year present worth. For the 50-year period of analysis (December 31, 2006 through December 31, 2056), all costs considered shall be escalated to the estimated center of the construction period in the analysis. The discount rate should be established at 6-3/8%. As a measure of cost-effectiveness, the unit cost of phosphorus removal shall be calculated as the total costs divided by the total kilograms of phosphorus removed over 50 years.

Example:

Basin X, Alternative 1 consists of a basin-scale treatment facility.
50-yr present worth of public cost =
$50 million (capital) + $50 million (O&M) = $100 million
Hence, the result for this criterion is $100 million
Unit cost of phosphorus removal = $100.0 million / 10.0 metric tons/yr for 50 years = $200/kg
Hence, the result for this criterion is $200/kg

3.2.4 Summary of Evaluation Criteria.

A summary of the evaluation criteria is presented in Table 5. To aid this process, a multi-criteria decision-making process will be used subsequent to the technical evaluation. During this process, weighting factors for the criteria will be developed in concert with stakeholders, and sensitivity analyses will be performed to demonstrate how the "optimal solution" would differ based on changes in the relative weights. More information on this process is provided in Section 5.

Table 5. Summary of Evaluation Criteria

Evaluation Criteria	Unit	Source of Data
Technical Performance Criteria		
Level of phosphorus load reduction	%	BSFS
2A. Long-term flow-weighted mean phosphorus concentration achieved	ppb	BSFS
2B. Long-term geometric mean phosphorus concentration achieved	ppb	BSFS
Implementation schedule	years	BSFS
Operational flexibility, including adaptive Management	-3 worst +3 best	STSOC
Resiliency to extreme conditions	-4 worst +4 best	STSOC
Assessment of full-scale construction and operation	-3 worst +3 best	STSOC
Management of side streams	-3 worst +3 best	STSOC
Environmental Criteria		
Level of improvement in non-phosphorus parameters	-19 worst +19 best	STSOC
Economic Criteria		
50-yr Present Worth Public Cost	$	BSFS
Cost-effectiveness	$/kg	BSFS

Abbreviations: BSFS – Basin-Specific Feasibility Studies
STSOC – Supplemental Technology Standard of Comparison

3.3 Key Uncertainties and Proposals for Addressing Them

A tremendous amount of research, data analyses, rulemaking, planning and basin-specific evaluations must be completed in a short time to develop integrated water quality plans and long-term permit applications by December 31, 2003. In order to meet the ambitious time frames mandated in the EFA, the District will be required to make recommendations for the long-term solutions based on incomplete science, engineering and regulatory information, which carries associated environmental and economic risks. The Evaluation Methodology needs to recognize and deal with regulatory, scientific, engineering and other uncertainties. In general, there are two types of uncertainties: (1) lack of knowledge surrounding a critical evaluation criterion or parameter; and (2) natural variability of the "true" values of the critical criterion or parameter. Each area requires a distinct approach for addressing the uncertainty. Addressing a lack of knowledge generally requires defining a reasonable range of probable values, while addressing natural variability generally requires formulating an estimate of the underlying probability distribution of the "true" values of the critical criterion or parameter, and subsequently simulating a range of outcomes, usually by using a Monte Carlo technique. In addition, the use of best professional judgment and well-documented assumptions will be necessary during the conduct of the Basin-Specific Feasibility Studies whenever uncertainties are encountered.

The key uncertainties in the information base for the long-term decisions, many of which are outside the control of the District, are summarized below, along with the proposed approach for dealing with the specific uncertainty.

3.3.1 Lack of Basin-specific Total Phosphorus Discharge Target

This design parameter is of paramount importance. Differences between an assumed target and the target identified after completion of the regulatory process could result in significant differences in the recommended long-term water quality solution. The three primary features comprising the basin discharge target are described below.

A. **Lack of a Class III numeric phosphorus criterion for the EPA.** The Florida Department of Environmental Protection (FDEP) is set to initiate rulemaking this year, however, it may be the end of 2003 before a standard is actually adopted. By that time, alternative long-term water quality solutions need to be identified, evaluated and selected; in addition permit applications need to be submitted to FDEP by December 2003. A default criterion of 10 ppb is to be set if FDEP fails to adopt the standard by December 2003. At the present time, it is not unreasonable to expect that the criterion will be close to 10 ppb.

B. **Lack of a methodology to be used to determine compliance with the Class III numeric phosphorus criterion for the EPA.** The methodology will define measurement locations, frequency of sampling, and temporal averaging period (e.g., daily, monthly or annual), and whether concentration, loads or both will apply. The FDEP is set to initiate rulemaking this year, however, it may be the end of 2003 before a compliance methodology is actually adopted. The Act provided the following guidance:

> *Compliance with the phosphorus criterion shall be based upon a long-term geometric mean of concentration levels to be measured at sampling stations recognized from the research to be reasonably representative of receiving waters in the Everglades Protection Area, and so located so as to assure that the Everglades Protection Area is not altered so as to cause an imbalance in natural populations of aquatic flora and fauna and to assure a net improvement in the areas already impacted.*

C. **Lack of a defined relationship between waters entering the Everglades and the resulting water quality in the EPA.** This relationship is critical because it relates the end-of-pipe concentration (design discharge target) to the interior marsh concentration and potential compliance locations.

Options. The basin-specific discharge target is critically important in determining the appropriate water quality treatment solution. Options for addressing the uncertainty include

1. Setting a range of phosphorus discharge targets for each basin, e.g., from 10 ppb to 20 ppb.
2. Determining the best possible water quality performance for each alternative.
3. Definition of Planning Level Target For Biological Treatment Systems: For those alternatives requiring a new or expanded biological treatment system, the consultant should size the biological treatment system to achieve a planning level target of a geometric mean of 10 ppb, as long as the flow-weighted mean is no less than the flow-weighted mean determined by the prototype data set used to calibrate DMSTA for the specific vegetation community. In no case shall the DMSTA model be used to extrapolate results below the flow-weighted mean for the calibration data set. This definition is analogous to "the lowest sustainable TP concentration" for a given vegetation community. Both the long-term flow-weighted mean and the long-term geometric mean of weekly flow weighted means from DMSTA model will be reported.

Proposed Approach for addressing these three uncertainties: Option 3 is proposed.

3.3.2 Uncertain effectiveness and cost of phosphorus source controls in upstream basins

The optimal solution for ensuring compliance with long-term water quality goals will likely be a mixture of private and public works. Each basin will likely have a unique ratio of private/public obligation. The District is implementing a Regulatory Action Strategy in those basins that do not include an STA. Because limited information on BMP effectiveness and costs exists at this time, best professional judgement will be used in the evaluation.

> **Proposed approach:** Since insufficient information exists to project with great certainty the performance and cost of source controls, a range of load reductions will be utilized in this evaluation (e.g., between 0% and 25% load reduction) for each basin. It is assumed that there will be no reduction in flow due to source controls.

3.3.3 Uncertain effectiveness and cost of phosphorus treatment performance of basin-scale treatment solutions

The District is presently examining the technical efficacy, costs, and implementation schedules of advanced phosphorus reduction treatment alternatives. Fundamental demonstration research results will be presented in the final reports for each technology:

> Chemical Treatment – High Rate Sedimentation: August 2000
> Chemical Treatment – Microfiltration: October 2000
> SAV: March 2002 (DMSTA model calibration expected to be complete Summer 2001)
> PSTA: November 2001 (DMSTA model calibration expected to be complete Summer 2001)

> **Proposed Approach:** For the biological-based "green" technologies, an idealized treatment area is proposed, consisting of an emergent marsh on the front end followed by an SAV/PSTA system on the back end. This component will utilize a composite set of parameters for the DMSTA model based on the best professional judgement of District staff and the DMSTA model developers. During the evaluation, a sensitivity analysis will be conducted to estimate the impact of varying the critical DMSTA parameter values on the resulting phosphorus performance. In addition, an appropriate contingency cost factor (e.g., 30%) will be included in the cost evaluations estimates
>
> For the chemical treatment options, the demonstration project final reports will be used.

3.3.4 Uncertain modifications to the flows and phosphorus loads resulting from CERP components, along with implementation schedules

Projects of the Comprehensive Everglades Restoration Plan (CERP) are planned for many of the basins that discharge into the EPA; these projects will significantly influence the current flows and phosphorus loads to the EPA.

Options:

1. Flows could be estimated from a 2050 full-CERP SFWMM simulation. Flows associated with the CERP projects could be used to generate a time series of inflow phosphorus data using the same algorithms as was used in the Baseline Data Sets (Goforth and Piccone 2001). This inflow time series could be input to a DMSTA model to create a time series of phosphorus outflows from the CERP project.
2. The DMSTA model could be used to estimate the outflow volumes and phosphorus time series from the CERP project. The 1965-95 baseline data set will then be modified based on these simulated flows and phosphorus data, and a revised baseline data set will be used in evaluating alternatives that include CERP projects.

Proposed Approach: It is proposed to Option 1. In addition, the Act requires consideration of water quantity, distribution, and timing for the Everglades Protection Area, factors that are explicitly addressed by CERP, and will not be an independent part of this evaluation.

<u>3.3.5 The amount of land available for treatment facilities in each basin is unknown</u>

Average land prices (+/- 30%) obtained from the District's Real Estate Division in April 2001 are provided in Table 6 for use in evaluating alternatives, however, no discussions have taken place with landowners regarding availability of land for treatment facilities.

Proposed Approach: During the conduct of the feasibility studies, work will proceed under the assumption that sufficient land will be available for the treatment works. Actual land availability will be finalized during subsequent steps in the decision-making and design process.

<u>3.3.6 "Compatibility" with receiving waters is undefined</u>

As stated above, the 1994 Everglades Forever Act requires consideration of the compatibility of the treated water with the balance in natural populations of aquatic flora or fauna in the Everglades Protection Area. Despite several years of investigation, no consensus has been reached on a regulatory definition for "compatibility". During the demonstration research projects for the STSOC, the potential toxicity of advanced treatment technologies was investigated as a measure of compatibility, and these STSOC results will be incorporated. Three options were considered for addressing this uncertainty in these feasibility studies:

1. Stakeholders will continue seeking a definition of "compatibility". If that definition is available during the feasibility studies, and if sufficient existing data are available to assess compatibility, then it will be used in the feasibility studies and an additional compatibility criterion will be added to the Evaluation

Methodology. If, however, the definition is not formalized in time, i.e., if consensus is reached subsequent to the feasibility studies, the issue of compatibility will be addressed during the permitting process.

2. Focus on those water quality parameters that do not have a State standard and are either added to the water during the treatment process or are significantly altered during the treatment process. For alternatives with a public works component, the data used in this evaluation could come from the demonstration project for each individual treatment technology (if monitored). For alternatives with no basin-scale public works component, the data used in this evaluation will be based on best professional judgement.
3. The estimated phosphorus concentration for the alternative could be used as a surrogate for compatibility with receiving waters by use of the following (or modified as appropriate) relationship:

Surrogate for Compatibility with Receiving Waters

Long-term Flow weighted Mean Discharge Concentration of Phosphorus (ppb)	**Score**
<10	5
10 – 15	4
15 – 20	3
20 - 25	2
25 – 30	1
>30	0

Proposed Approach: Option 1 above. However, all evaluations of alternatives should include a statement that marsh compatibility is a topic of on-going study, and that additional treatment features may be necessary prior to finalizing the design.

With respect to chemical treatment alternatives, please note the following:

1. The purpose of the buffer cell recommended by the CTSS final report was to equalize any variations in the pH, color and alkalinity of the treated effluent from the CTSS process, and not as a means to ensure compatibility with receiving waters:

> "The CTSS process reduced the alkalinity, color and pH of treated waters and use of a treatment effluent buffer cell has been suggested for incorporation in to the full-scale design for effluent conditioning." (see page 20 of the CTSS Final Report, December 2000)

2. Marsh readiness testing protocols, including 7-day chronic renewal toxicity screening, 14-day algal growth potential screening, and 96-hour chronic stain non-renewal screening, were completed during the CTSS testing with EAA waters and in urban testing in the Wellington and C-11 basins. No significant or sustained adverse effects were observed relating to the CTSS effluent samples. "Bioassay and AGP studies conducted on representative CTSS feed and effluent samples demonstrated no significant adverse impact on receiving waters." (see page 20 of the CTSS Final Report, December 2000).

3. Finally, previous and current research on the performance of a buffer marsh following chemical addition indicates that even though the marsh buffers some of the water quality parameters (e.g. pH and alkalinity), it also releases phosphorus from the sediments to the final effluent. Based on the results of the Managed Wetlands research project, District researchers are concerned that a post-treatment marsh may elevate TP levels in the effluent prior to final discharge. We note that a post-treatment settling basin is now recommended to capture any floc overflowfrom the CTSS process. In addition, it is proposed to use mechanical monitoring and control to adjust the pH and alkalinity after the settling

3.3.7 Lack of revised water quality standards for parameters other than phosphorus applicable to the EPA and classification of EAA canals

The EFA directs the District and FDEP to complete any additional research to evaluate existing water quality standards applicable to the Everglades Protection Area and classification of EAA canals. To date, FDEP has conducted extensive data evaluations, particularly for dissolved oxygen, as reported in the *Everglades Consolidated Report*. However, it is not certain if this evaluation will result in any revisions to State water quality standards, which may, in turn, have an influence on the long-term water quality solutions.

Proposed approach: It is proposed that the evaluation will use the assumption that existing water quality standards are applicable to the Everglades Protection Area. In conjunction, the results of the STSOC chemical analyses will be used for this evaluation. Should FDEP present its findings prior to the completion of the feasibility studies, adjustments would be made as appropriate.

3.3.8 Allowance for bypass of treatment facilities

The design of the ECP incorporated a 0% bypass of the 10-year base period of record (1979-88) storm flows. In order to cover a wider range of possibilities, the STSOC used a range of 0%, 10% and 20% bypass. Eleven of the thirteen basins being evaluated contain pump stations that discharge into the Everglades Protection Area. These pump stations provide drainage rates that range from approximately 0.5 inches per day to 1.5 inches per day. In general, these pump station capacities do not correspond to any specific "design storm", but rather, the pump stations were historically sized to provide a reasonable drainage rate for the basin land use. Provisions for hydraulic bypass around these structures do not exist. For these basins, storm flows in excess of the pump station capacities result in discharges equal to the pump capacity, in association with increased stages within the basin. Two of the thirteen basins being evaluated contain spillways that discharge into the Everglades Protection Area. The Feeder Canal Basin discharges through a gated spillway (S-190), while discharges from the C-139 Basin enter STA-5 through spillways. In both instances, provisions for hydraulic bypass are available. For these two basins, storm flows in excess of the design capacities can result in discharges from the basin above the design capacity, in association with increased stages within the basin.

> **Proposed Approach:** For the purpose of evaluating alternatives, it is proposed that the treatment facilities will be sized to capture the simulated 1965-95 flows with no hydraulic bypass. A 0% bypass condition should also ensure that existing flood protection in each basin is not compromised by any alternative. For the two basins with spillways that discharge into the EPA, the evaluation will include a sensitivity analysis showing the influence on TP performance and cost estimates (not a full evaluation) of bypass of storm flows having a 10% annual probability of exceedance, based on the 31-yr simulated period of record flows.

3.3.9 Lack of funding for long-term solutions, including resolution of the public/private mix of funding

The ultimate determination of long-term basin-specific water quality solutions will likely be based on available private and public funding mechanisms.

> **Proposed Approach**: Proceed with evaluation of alternatives as a fact-gathering exercise. The final combination of water quality measures will be basin-specific and eventually decided by policy makers (Legislature, local governments, etc.) based on the results of the feasibility studies and consideration of funding. However, the current lack of funding for the long-term solutions should not delay the investigation of basin-specific feasibility studies.

Table 6. Preliminary Basin-specific Cost Estimates for Land

BASIN	Unit Cost $/acre	Contingency	Comments
S-5A	$6,200	30%	
S-6	$10,500	30%	Land adjacent to STA-2 are owned by District for EAA Reservoir
S-7	$2,800	30%	Land adjacent to STA-3/4 are owned by District for EAA Reservoir
S-8	$2,800	30%	Land adjacent to STA-3/4 are owned by District for EAA Reservoir
C-139 (including the Annex)	$3,000	30%	Land between STA-5 and STA-6 is owned by District for EAA Reservoir
C-51 West	$15,000	50%	Only available land is north of C-51 Canal
North Springs Improvement District	$20,000	50%	
North New River Canal	$20,000	50%	
C-11 West	$20,000	50%	
Feeder Canal	$1,200	50%	
L-28	$1,200	50%	
ACME Basin B	$21,500	30%	May need to be reviewed based on sale of Section 34

3.4 Proposed Methodology

Based on the above statutory guidance and key uncertainties, a methodology is proposed to evaluate alternative combinations of private works and public works to achieve compliance with the long-term water quality standards for the Everglades Protection Area. The major steps in this methodology are summarized below. To aid this process, a multi-criteria decision-making process will be used subsequent to the technical evaluation. During this process, weighting factors for the criteria will be developed in concert with stakeholders, and sensitivity analyses will be performed to demonstrate how the "optimal solution" would differ based on changes in the relative weights. More information on this process is provided in Section 5.

Step 1. Finalize the basin-specific combinations of source control and basin-level treatment that define each alternative. These alternatives will be finalized after workshops with stakeholders in each basin.

Step 2. Modify the Baseline data set daily time series to reflect the assumed phosphorus reduction of the basin source controls as part of the sensitivity analysis that will be performed.

Step 3. Modify the Baseline data set daily time series to account for the CERP project, or other conversions in land use, if present in the alternative. For those alternatives that have a change in the baseline flows due to conversion of drainage area into project features (such as an STA), etc., the evaluation will use the same daily phosphorus concentration as in the Baseline data set in order to preserve identical areal mass loadings.

Step 4. If a chemical treatment facility is part of the alternative, the sizes of the flow equalization basin and chemical treatment modules (e.g., 50 MGD units) will be estimated by use of the Chemical Treatment Spreadsheet discussed in Section 4.2.

Step 5. Set up the DMSTA model (see description in Section 4.1)

a. If the land area is a variable, iteration may be required to identify the area required to achieve the lowest phosphorus discharge concentration, or 10 ppb, whichever is higher.
b. If the land area is fixed (e.g., in the ECP basins), then DMSTA will be run to estimate the resulting discharge phosphorus concentration.
c. A sensitivity analysis will be conducted on the DMSTA results. For example, the key parameters of DMSTA could be varied from –50% to +100%, and a range of phosphorus concentration results could be generated and compared.

Once the DMSTA modeling is completed, the following evaluations will be conducted.

Step 6. Technical Performance Evaluation Criteria Nos. 1-2: The level of phosphorus load reduction and average annual outflow phosphorus concentration will be calculated as the difference between the baseline value and the alternative value(s) for the 31-year average annual load.

Step 7. Technical Performance Evaluation Criterion No. 3 - An estimate of the implementation schedule for the alternative will be developed, including land acquisition, design, construction and sufficient operation to achieve stable performance.

Step 8. The following Technical Performance Evaluation criteria will be evaluated based on information provided by the STSOC:

Evaluation Criterion No. 4 - Assessment of full-scale construction and operations.
Evaluation Criterion No. 5 - Resiliency to fire, flood, drought and hurricane.
Evaluation Criterion No. 6 – Operational flexibility.
Evaluation Criterion No. 7 - Level of effort required to manage side streams.

Step 9. Environmental Evaluation Criterion No. 1 - The level of improvement in non-phosphorus parameters will be summarized.

Step 10. Economic Evaluation Criteria Nos. 1-2 - Cost. A conceptual-level layout of the basin-scale facility, if included, will be generated. 50-year present worth estimates of capital, operation and maintenance costs will be developed, consistent with the method used in the STSOC guidelines. Using the load reduction estimates developed above, the unit cost for phosphorus removal will also be calculated.

Step 11. Summarize the results of the evaluation in a draft report to be presented at a public workshop.

Step 12. Finalize the results of the evaluation in a final report to be presented to the District Governing Board.

4.0 ANALYTICAL TOOLS

4.1 DMSTA Description

Dynamic Model for Stormwater Treatment Areas (DMSTA) was developed by Drs. Bill Walker and Bob Kadlec for the U.S. Department of the Interior. The STAs were sized using a steady-state model calibrated to soil & water-column phosphorus data from Water Conservation Area 2A. The DMSTA is an enhanced spreadsheet-based model that provides a framework for integrating experimental & field-scale monitoring data and can be used in developing designs for the next generation of treatment areas. The details of the model development and use can be found at the web site: http://wwwalker.net/dmsta/index.htm.

4.1.1 Factors Considered by DMSTA, but not by the Steady-State STA Design Model

Temporal Variations in Inflow Volume, Load, Rainfall, & ET
Hydraulic Compartments (Cells, Flow Distribution Levees)
Hydraulic Efficiency (Number of Stirred Tanks in Series)
Cell Aspect Ratio (Length:Width)
Water Level Regulation
Outflow Regulation (Discharge vs. Water Level)
Compartmentalization of Biological Communities
Dry-Out Frequency & Supplemental Water Needs
Bypass Frequency, Quantity, & Quality
Seepage Collection & Management

4.1.2 Input Data Requirements

Morphometry (Length, Width, Area, Cell Configuration)
Hydraulic Efficiency (Number of Stirred Tanks in Series)
Daily Time Series:
- Inflow & Outflow Volume
- Inflow & Outflow Concentration
- Mean Depth
- Rainfall
- Evapotranspiration

Descriptive Data:
- Seepage Rates
- Community Description
- P Storage (metadata: macrophytes, periphyton, soil)

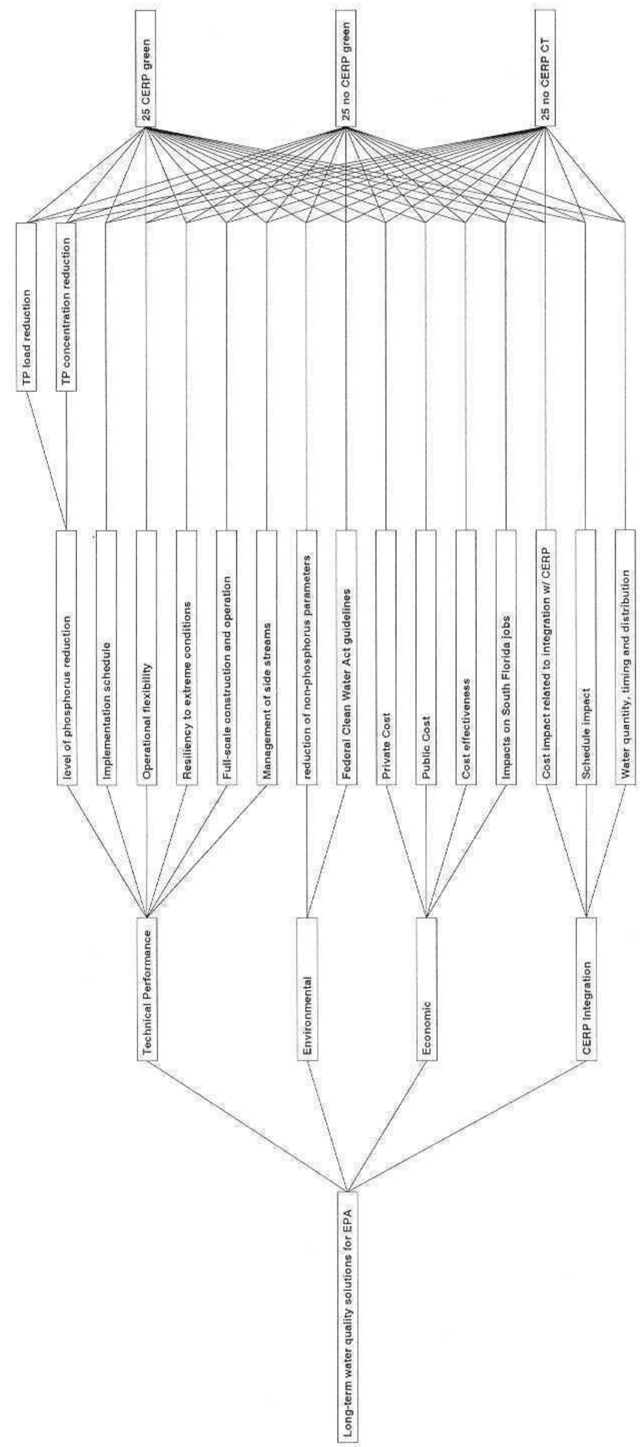
4.2 Chemical Treatment Facilities Spreadsheet

A spreadsheet tool was developed during the demonstration research project for chemical treatment. The spreadsheet accepts daily flow data and can be used to size flow equalization basins and overall treatment plant capacity.

5.0 POST-EVALUATION DECISION MAKING PROCESS

The evaluation of alternative water quality improvement strategies described above is a fact-gathering activity, and by itself cannot determine or recommend an "optimal" combination of water quality treatment solutions. However, the results of the evaluation will give the Florida Legislature, the District Governing Board, and other stakeholders the critical technical information necessary to make the policy decisions needed determine the "optimal" combination of water quality treatment solutions. To aid this process, a multi-criteria decision-making process will be used subsequent to the technical evaluation. During this process, weighting factors for the criteria will be developed in concert with stakeholders, and sensitivity analyses will be performed to demonstrate how the "optimal solution" would differ based on changes in the relative weights. An example of the decision hierarchy diagram associated with such a process is presented in Figure 2. It is proposed to use the software Criterium Decision Plus produced by Infoharvest, Inc. (1997). This software features the ability to handle multiple layers of criteria and subcriteria, offers multiple probability distribution functions to handle uncertainty, multiple options for scaling the values for each criterion, comprehensive sensitivity analyses, highly interactive graphics for use in consensus building, easy documentation of assumptions made and the reasons for intermediate decisions, and offers both the S.M.A.R.T. and AHP algorithms. Additional details are found on the website

http://www.Infoharvest.com


25 CERP green
25 no CERP green
25 no CERP CT
TP load reduction
TP concentration reduction
level of phosphorus reduction
Implementation schedule
Operational flexibility
Resiliency to extreme conditions
Full-scale construction and operation
Management of side streams
reduction of non-phosphorus parameters
Federal Clean Water Act guidelines
Private Cost
Public Cost
Cost effectiveness
Impacts on South Florida jobs
Cost impact related to integration w/ CERP
Schedule impact
Water quantity, timing and distribution
Technical Performance
Environmental
Economic
CERP Integration
Long-term water quality solutions for EPA

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ATTACHMENT 1

STSOC GUIDELINES FOR COST ESTIMATES

	Item/Task	Unit	Unit cost	Quantity	Total	Comments/Explanation
1	**Capital costs**					
1.1.1	Equipment		$ -		$ -	
1.1.2	Residuals management		$ -		$ -	
1.2	Freight		$ -		$ -	
1.3	Installation		$ -		$ -	
1.4	Instrumentation		$ -		$ -	
1.5	Electrical controls					
1.5.1	Electrical controls					
1.5.2	Electrical power distribution	$/mile	$ 80,000			
1.6	Civil Work- water control structures					
1.6.1	84" culvert open	per structure	$ 20,000			
1.6.2	84" culvert with gate	per structure	$ 35,000			
1.6.3	With gates	per structure	$ 300,000		$ -	
1.6.4	Without gates	per structure	$ 150,000		$ -	
1.7.1	Canals (digging - no blasting)					
1.7.1.1	Canals- Deep excavation	$/cubic yard	$ 3.50		$ -	
1.7.1.2	Canals- Shallow excavation	$/cubic yard	$ 2.50		$ -	
1.7.2	Canals (including blasting)					
1.7.2.1	Canals- Deep excavation	$/cubic yard	$ 4.50		$ -	
1.7.2.2	Canals- Shallow excavation	$/cubic yard	$ 3.50		$ -	

	Item/Task	Unit	Unit cost	Quantity	Total	Comments/Explanation
1.8.1	Levees (no blasting)					
1.8.1.1	Internal- 7' (4.5' SWD)	$/mile	$ 390,000		$ -	
1.8.1.3	External- 8' (4.5' SWD)	$/mile	$ 485,000			
1.8.1.4	External- 9' (4.5' SWD)	$/mile	$ 562,000		$ -	
1.8.1.5	External-10' (4.5' SWD)	$/mile	$ 703,000			
1.9	Pumping stations					
1.9.1.1	0-40 cfs	$/cfs	$ 7,600		$ -	
1.9.1.2	41-60 cfs	$/cfs	$ 9,500		$ -	
1.9.1.3	60-500 cfs	$/cfs	$ 9,900		$ -	
1.9.1.4	500-3,000 cfs	$/cfs	$ 7,500		$ -	
1.10	Interior land preparation					
1.10.1	Disking	$/acre	$ 60		$ -	
1.11	Land					
1.11.1	Equalization basin	$acre	$ 4,655			
1.11.2	Treatment	$/acre	$ 4,655			
1.11.3	Polishing, administrative, etc.	$/acre	$ 4,655			
1.11.4	Residuals management	$/acre	$ 4,655			
1.12	6" gravel access roads (12 ft wide road)	$/linear ft	$ 150		$ -	
1.13	Engineering and Design costs	Lump sum				
1.14	Contingencies	Lump sum				
TOTAL CAPITAL COSTS						
2	**OPERATING COSTS (per year)**					
2.1	Labor				$ -	
2.1.1	Engine operator/Maintenance mechanic	each	$ 50,000			

	Item/Task	Unit	Unit cost	Quantity	Total	Comments/Explanation
2.1.2	Lead operator	each	$ 60,000			
2.2.1.1	Mechanical maintenance (lubrication, spare parts, etc.)- 500- 3,000 cfs pumps	per unit	$ 23,000		$ -	
2.2.1.2	Mechanical maintenance- 0-500 cfs pumps	per unit	$ 10,000			
2.2.2	Maintenance (water control structures)	each	$ 12,000		$ -	
2.2.3	Maintenance (building)	per unit	$ 12,000		$ -	
2.2.4	Maintenance- Levees	$/mile	$ 1,530		$ -	
2.2.5	Maintenance (vegetation control)	$/acre	$ 22		$ -	
2.2.6					$ -	
2.2.7					$ -	
2.2.8	Maintenance- Sludge treatment		$ -		$ -	
2.3	Chemicals					
2.3.1	Aluminum sulfate	Dry ton	$ 150		$ -	
2.3.2	PAC	lb	$ 0.20		$ -	
2.3.3	Ferric chloride	Dry ton	$ 180		$ -	
2.3.4	Ferric sulfate	lb	$ 0.40		$ -	
2.3.5	Lime		$ -		$ -	
2.3.6	Polymer	Tons	$ 4,000		$ -	
2.3.7	Others		$ -		$ -	
2.4	Solids disposal	Tons	$ 50		$ -	
2.5	Energy		$ -		$ -	

	Item/Task	Unit	Unit cost	Quantity	Total	Comments/Explanation
2.5.1	Electricity	KW/hr	$ 0.08			
2.5.2	Fuel consumption	acre-feet	$ 0.50			0.55 gal/acre-foot @ $0.9/gallon
TOTAL OPERATING COSTS:						
3	**Salvage/Demolition/Replacement costs**					
3.1	Demolition costs				$ -	
3.2	Restoration of levees	$/yard	$ 3		$ -	
3.3	Restoration of FEBs		$ -		$ -	
3.4	Clearing and grubbing		$ -		$ -	
	Light folliage	$/acre	$ 300			
	Forest/heavy brushes	$/acre	$ 1,500			
3.5	Replacement items		$ -		$ -	
TOTAL DEMOLITION/REPLACEMENT COSTS						
4	**Lump sump/ Contingency items**					
4.1	Telemetry					Project specific
4.1.1	Pump stations	$/unit	$ 50,000			
4.1.2	Water control structure	$unit	$ 25,000			
4.2	FPL improvements	Lump sum	$ -		$ -	
4.3	Administrative facilities	Lump sum	$ -		$ -	
4.4	Sampling and monitoring	Lump sum	$			
TOTAL LUMP SUM ITEMS					$ -	

Appendix A

Following is a brief summary of revisions made to the August 31, 2001 version of the Evaluation Methodology document. These revisions were made based on feedback received from internal and external reviewers, stakeholder comments, and consultant peer-review comments:

1. Based on feedback received from District researchers, references to a post-treatment settling marsh and/or polishing marsh have been removed from the CTSS references in the Evaluation Methodology.
2. References to the District's BMP Manual were removed, as it will not be complete in time for use in the feasibility studies. The impact of source controls on each alternative's performance will be handled with a sensitivity analysis during the evaluation of alternatives.
3. Technical Performance Criterion No. 2 was changed from "Level of Phosphorus Concentration Reduction" to "Average Annual Outflow Concentration Achieved".
4. The criterion for the Clean Water Act guidelines (Table 4) has been removed from the Evaluation Methodology. Compliance with the Clean Water Act guidelines will be addressed in the NEPA process during the permitting phase for the recommended alternatives.
5. Economic Criterion No. 4 "Impacts on South Florida Jobs" was removed from the Evaluation Methodology. Socio-economic issues will be addressed in the NEPA process during the permitting phase for the recommended alternatives.
6. CERP Integration Criteria Nos. 1-3 were removed from the Evaluation Methodology because they were already addressed under other criteria and were redundant. Analyses of the impacts of integrating with CERP projects will be included during the development and evaluation of alternatives for each of the basins.
7. Section 3.3.6 "Compatibility" was revised to indicate that if the FDEP defines this issue in time for inclusion in the feasibility studies, and sufficient data exist, an additional criterion will be added to the Evaluation Methodology to address the compatibility issue.
8. Section 3.4 "Proposed Methodology" was revised as appropriate to reflect changes made to the evaluation criteria listed above.
9. The scoring ranges for three of the qualitative criteria were changed from "1 (worst) to 10 (best) " to "-3 (worst) to +3 (best)". The scoring range for the fourth qualitative criterion was changed from "1 (worst) to 10 (best) " to "-4 (worst) to +4 (best)".

Appendix B

Following is a brief summary of revisions made to the November 14, 2001 version of the Evaluation Methodology document. These revisions were made in response to comments from the FDEP and various stakeholders.

1. A statement was added to the "Introduction" that the research efforts have culminated in reduction down to two technologies: biological and chemical.
2. "Section 3.1.6" was revised regarding the issue of "compatibility".
3. The document was revised throughout to indicate that the consultants will report "results" not "scores" for each of the evaluation criteria. "Scoring" will be performed subsequent to the evaluation process described in the Evaluation Methodology.
4. "Technical Performance Criterion No. 2" was revised to include both the long-term flow-weighted and the long-term geometric mean phosphorus concentration.
5. "Technical Performance Criterion No. 4" was revised to clarify that the consultants must use best professional judgement to evaluate combinations of technologies.
6. In the example for "Technical Performance Criterion No. 4", the last sentence, which read "It is reported that this feature allows this technology to consistently produce an acceptable effluent water quality", was removed because it was not relevant to this criterion.
7. "Economic Evaluation Criterion No. 1" was revised to indicate that costs should be escalated to the estimated center of the construction period.
8. "Table 5. Summary of Evaluation Criteria" was revised to include both the long-term flow-weighted mean and the long-term geometric mean phosphorus concentration.
9. "Section 3.3.1" was revised to include "Definition of Planning Level Target for Biological Treatment Systems".
10. "Section 3.3.2" was revised to include a statement that it is assumed there will be no reduction in flow due to source controls.
11. "Section 3.3.3" was revised to include a statement that a contingency factor will be included in the cost estimates.
12. "Section 3.3.6" was revised regarding the process to reach consensus on the issue of "compatibility".
13. "Section 3.3.6" was revised to indicate that all evaluations should include a statement that marsh compatibility is a topic of on-going study, and that additional treatment features may be necessary prior to finalizing designs.
14. "Section 3.3.6" was revised to include statements on chemical treatment alternatives and the issue of marsh compatibility.
15. "Section 3.3.7" was revised to include an update on FDEP's review of the non-phosphorus water quality standards.
16. "Section 3.3.8" was revised to include a proposed approach for addressing bypass of treatment facilities.
17. "Step 3" of "Section 3.4 Proposed Methodology" was revised.